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Contents

Choosing Common Names

THE PROBLEM of assigning common names for pesticides is a perennial one which often appears to cause more headaches than the pests themselves.

There are two main routes by which the goal of one common name for one pesticide is attained: in the first instance an approved name is applied for and obtained before the chemical is marketed under a trade name and in published reports the product is referred to by its chemical name or the mythical 'Compound X' until a common name is found e.g. diquat. Secondly the company discovering the chemical uses one of its own proprietary names but as soon as it is evident that the product will be a commercial proposition all rights to the name are relinquished so that it can become a recognised common name e.g. malathion, diazinon, simazine (in U.K.).

Both methods have their disadvantages, in the first case unless pesticides are assigned a common name whilst still undergoing trials, scientific literature is liable to be fraught with Compound X's and tongue twisting chemical names. On the other hand by assigning a standard name early in a chemical's career a perfectly good name may be lost if the product fails to come up to expectations. In the second case the individual company's choice may not meet with approval of the Standards Committee—such names as 'bugicide' and 'flynomo' would definitely be frowned on. Again a perfectly good name could be lost if the product fails to come up to expectations.

On balance it would appear that it would be best for the first short name used for the pesticide to be chosen by a Standards Committee with a view to that name becoming the standard common name and all pesticide manufacturers should be encouraged to follow this policy of obtaining standard common names before using a trade name. They should also be encouraged to use the common name in conjunction with their company's proprietary name in *all* their technical and trade literature. In this country at least the companies which already carry out this policy do not appear to have suffered in any way.

The Pest Control Products Standards Committee, which produces B.S.I. Recommended Common Names for pesticides, already appear—if one can judge from the recent speed up in assigning names—to be following this policy to some extent but to be really successful it must be adopted on an international scale.

Furniture Beetle Anobium punctatum (Degeer) *adults and exit holes. A Shell photograph.*

DIELDRIN IN WOOD PRESERVATION

By J. G. ATTFIELD, B.Sc.*

DIELDRIN is a powerful insecticide of the chlorinated hydrocarbon group and has been widely used since 1940 for control of a wide range of domestic, industrial, public health and agricultural pests. It has physical, chemical and biological properties which experimental work and practical use have shown to be of great value against termites and wood boring beetles and is incorporated in many different types of products including the following : —

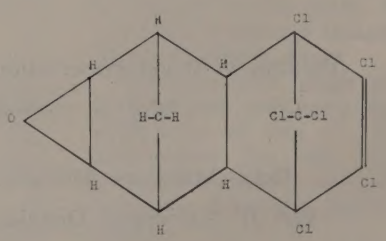
organic solvent type wood preservatives
insecticidal stains and polishes for wood
woodworm killers in pressure packs
formulations used for the control of termites on building sites
" Woodtreat " formulations for *in situ* treatments.

The properties responsible for the versatility of dieldrin in the preservative field will be reviewed in this article.

Physical and chemical properties

Dieldrin is the common name recommended by the British Standards Institute[1] for the insecticide containing 85% of the compound 1, 2, 3, 4, 10, 10-hexachloro-6, 7-epoxy-1, 4, 4*a*, 5, 6, 7, 8, 8*a*-octahydro-*exo*-1, 4-*endo*-5, 8-dimethanonaphthalene, abbreviated to HEOD, and 15% of compounds related to HEOD which have insecticidal activity. The formula of HEOD is given in Figure I.

FIGURE I.



Dieldrin is supplied to manufacturers of wood preservatives in the form of small, light tan coloured flakes and when dissolved in suitable solvents at the concentrations required for control of wood destroying insects does not discolour wood. When a non-staining preservative is required care must be taken of course that other ingredients such as fungicides, and solvents do not cause staining. Dieldrin itself does not taint foodstuffs in the vicinity of wood treated with preservatives containing it but again care in the choice of other ingredients must be exercised.

Dieldrin is soluble to a varying degree in all organic solvents, but generally speaking, it is most soluble in

* *Shell International*

aromatic hydrocarbons. There is therefore considerable scope both in the choice of solvents that may be used in the manufacture of dieldrin-based preservatives and the concentration of dieldrin in the preservative. (Table I).

During both formulation and application, organic solvent preservatives may need to be heated. It is important therefore that the insecticides and fungicides used should be stable at temperatures up to 200°F at least. Tests have shown that negligible decomposition occurs when HEOD—the main constituent of dieldrin—is heated at 200°F for many hours.

Dieldrin is very stable in the presence of ordinary basic reagents, alkaline oxidising agents, emulsifiers and solvents. It is stable with dilute acid but will react with concentrated mineral acids and acid catalysts and acid oxidising agents. Dieldrin itself is non-corrosive to most metals. Owing to its chemical stability, dieldrin may be mixed with most of the fungicides used in wood preservative formulations based on organic solvents.

Dieldrin is virtually insoluble in water—0.05 ppm at 70°F — and is therefore unlikely to be leached from treated wood, even under comparatively severe weathering conditions.

As well as being chemically stable and virtually insoluble in water, dieldrin has a very low vapour pressure i.e. 1.8 x 10^{-7} mm Hg at 70°F. These properties make for remarkable persistence—a most desirable feature of an insecticide for incorporation in wood preservatives.

Effect on insects

Dieldrin, which acts against insects both as a stomach and a contact poison, has been tested against a large number of insect pests in the laboratory and in the field. It is used in practice against a considerable number of important pests where its powerful insecticide action and its long residual life have proved of outstanding value. They include cockroaches, bed-bugs, mosquitoes, ants, clothes moths, locusts, grasshoppers, and many species of weevils, beetles, and caterpillars attacking crops and commodities in store. Dieldrin is one of the insecticides most extensively used on a world wide scale and its effectiveness against insect pests of timber fits into the general picture of dieldrin as an insecticide of wide and diverse application.

Dieldrin has been tested against the major groups of insect pests of timber and in all cases has proved to have a high order of insecticidal activity.

The toxicity of dieldrin and a number of other insecticides to various species of bark beetles has been determined by topical application at the California Forest and Range Experiment Station[2]. As will be seen from Table II it has a high degree of toxicity although endrin, lindane and EPN exhibited a somewhat higher effect.

TABLE I.

Approximate Solubility of Dieldrin in Solvents

Solvent	*Dieldrin % w/v at 77°F (25°C)*
Acetone	22
Benzene	40
N. Butyl Alcohol	5
Carbon Tetrachloride	38
Dutrex 3, % w. at 10°C.	17
Dichlorodiethyl ether, % w. at 70°F.	26
Fuel oil.	15
Diesel oil.	15
Methyl Ethyl Ketone.	32
Kerosene, odourless.	25
Low Aromatic White Spirit, % w	18
Xylene.	38
"Shellsol" A.	32
"Shellsol" N, % w. at 70°F.	25
"Shellsol" E, % w. at 70°F.	25

TABLE II.

Toxicity by topical application of dieldrin to bark beetles

Species of Bark Beetle	*LD90 and standard error (μg/mg body weight.)*
Dendroctonus brevicornis	0.0832± 0.0173
Dendroctonus monticolae	0.0195± 0.0035
Scolytus ventralis	0.00172± 0.00067
Melanophila californica *	0.0373± 0.0147

* *Fam. Buprestidae*

Numerous experiments in many parts of the world have demonstrated the value of dieldrin for control of Lyctus beetles. Experiments carried out at the Forest Products Research Laboratory in England have shown that immersion of European oak boards for 10 seconds in 0.5% and 1.0% emulsions protected them from damage by *Lyctus brunneus* for three years[3]. The treated boards were stacked out of doors during the period of the test. The tops of the stacks but not the sides were protected from the weather. Attention was drawn to the fact that the deposit of dieldrin (0.016—0.37 lbs. per 100 sq. ft.) applied in this way was of course superficial and is removed if the timber is planed or sawn.

Tests carried out by the Forestry Commision of New South Wales have also proved the effectiveness of dieldrin against *L. brunneus*[4].

In the United States chlordane and dieldrin have been compared by dipping pieces of red oak actively infested with larvae of *Lyctus planicollis* in emulsions of the insecticides for 2 hours, the results being assessed on loss of weight of the wood and subsequent emergence of adults. Chlordane at 2% and dieldrin at 0.5% gave complete control.

In a paper read at the British Wood Preserving Associations Convention in 1958 Dr. Becker[5], of the Bundesanstalt für Materialprüfung, Berlin, reported results establishing that dieldrin kills larvae of the common furniture beetle, *Anobium punctatum*. The

effectiveness of dieldrin against this pest is perhaps most convincingly demonstrated by the work of the Department of Scientific and Industrial Research of New Zealand. They are testing dieldrin, incorporated in the bonding glue, as a means of protecting plywood from attack by *Anobium*. A concentration of 0.3% dieldrin on the dry weight of glue has given complete protection since the tests were started in 1954.

Trials carried out by Dr. H. J. R. Durr[6] at the Entomological and Plant Quarantine Station in Cape Province, South Africa, and more recently by Dr. Becker[7], have illustrated the effectiveness of dieldrin for controlling the House Longhorn Beetle (*Hylotrupes bajalus*).

In the work carried out in South Africa, dieldrin was applied to wood blocks by dipping the wood in a 0.25% solution of dieldrin in white spirit for 30 minutes, a retention of 0.013 lbs. dieldrin per cu. ft. being obtained. In this test, none of the *Hylotrupes* larvae survived and no boring took place. In the trials carried out by Dr. G. Becker using dieldrin-treated plywood, good control of *Hylotrupes* larvae was obtained.

It can be concluded from the tests briefly described above that dieldrin is an effective insecticide against the major wood boring beetles. It has also proved an excellent weapon for use against termites which are such serious pests in tropical and sub-tropical countries. A number of trials demonstrating its value in this respect have been carried out and the results obtained by G. N. Wolcott in Puerto Rico are typical[8]. He found that soaking pieces of Flamboyan wood, *Delonix regia*, for 10 minutes in a 1% wt/wt solution of dieldrin in acetone gave protection from attack by the drywood termite *Cryptotermes brevis* for at least six years.

As well as being used to protect timber itself from termites, dieldrin is also used to kill subterranean termites inhabiting the soil of building sites and to protect premises erected on them from termite invasion. Subterranean termites cause by far the greatest proportion of damage to timber in buildings throughout the world. As these termites, together with the damp wood species, nest either in the ground or maintain contact with damp soil, protection of timber in buildings can be provided by creating an insecticidal barrier either between the nest in the wood and the ground, in the case of damp wood species, or between the termite nest in the ground and the wood in the building, in the case of the true subterranean species.

Dieldrin has been found to provide a method of control of subterranean termites that is both effective and persistent, when applied around and under the foundations of buildings. In tests carried out by H. R. Johnston[9] in the United States, dieldrin, when applied to the soil as emulsions containing 0.25% and 1% w/v dieldrin at 1 pint per sq. ft., has been found to protect wood in contact with the soil for at least 10 years.

Eradication of termites from building sites

The results of scientific testing of dieldrin against wood-boring beetles and termites in many parts of the world is reflected in its widescale use against insect pests of timber.

The work of Johnston and of other investigations on soil poisoning against termites has lead to the adoption of this method of termite control in a number of countries and to its recommendation for this purpose by a number of authorities including the Forest Service and the Federal Housing Administration[9] in the United States and the Commonwealth Scientific and Industrial Research Organisation in Australia[10].

In practice, a suitably formulated dieldrin concentrate is diluted with water or oil to give a 0.3%—0.5% w/v emulsion or solution which is then poured or sprayed into trenches alongside the foundations of the building. One gallon of the diluted solution or emulsion is used per yard run of trench in either two or three applications as the earth is filled back. Where concrete slab foundations are used in the construction of a building, the fill, when completed, should be treated with a dieldrin emulsion or solution at the rate of 1 gallon per 12 sq. ft.

Recent work by F. J. Gay and A. H. Wetherly of the Commonwealth Scientific and Industrial Research Organisation, Australia[11], has shown that concrete slab foundations, which often develop both small and large settlement cracks as well as having numerous spaces through which termites can enter the building, can be additionally proofed against termite entry and subsequent attack of the timber within the building by the use of dieldrin 0.5% w/v emulsion instead of water when mixing the concrete.

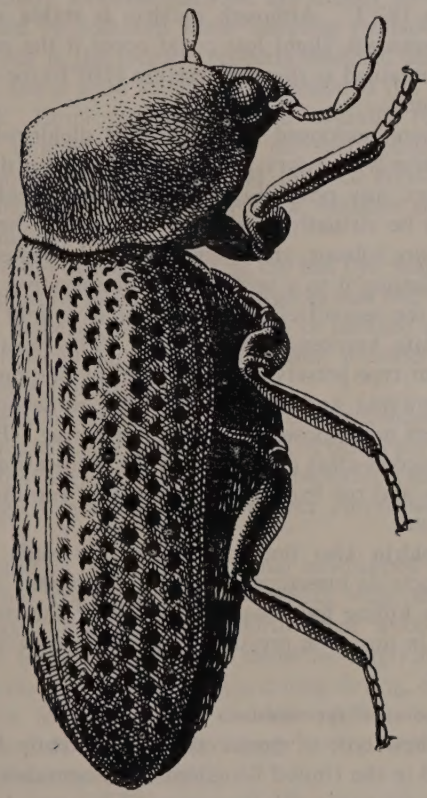
Insect-proofing of Plywood, Chipboard and Hardboard

One of the first tests to assess the value of dieldrin in plywood protection was started by the Department of Scientific and Industrial Research in New Zealand in 1954 and it is now more or less standard procedure for plywood manufacturers in New Zealand to incorporate dieldrin in plywood glues at a concentration of 0.3% wt., based on the made-up glue.

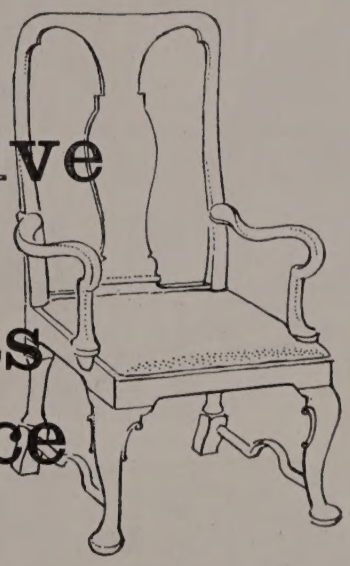
While some manufacturers are using dieldrin 50% wettable powder others are employing a method of adding dieldrin to glues which involves the use of a finely divided suspension of technical flake dieldrin in water; this suspension is prepared at the plywood factory by mixing the water and dieldrin, which is then homogenised.

Experimental work has been, and is being, carried out to determine the control provided by dieldrin, and also by the chemically related insecticide, aldrin, against termite and wood borer attack of reconstituted wood products such as hardboard and chipboard. It has been

dieldrin



so effective when insects menace man



Insects flying, crawling, boring, chewing — however they affect human health, comfort or possessions, a dieldrin formulation provides the most effective way of controlling the trouble. Dieldrin is highly persistent, virtually odourless, versatile, economical and easy to formulate. Weight for weight, it is the most efficient of all insecticides at present available. The low concentrations required for success mean significant saving in cost. Its many possible forms of application include residual and dual-purpose space sprays, paints and lacquers, aerosols, dusts, polishes and wood preservatives.

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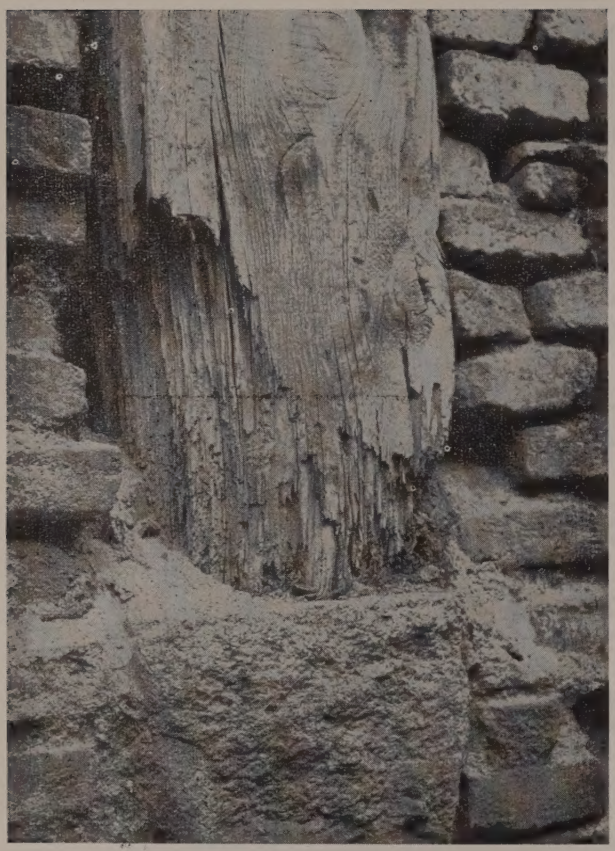

Damage to timber upright of a building in Madrid by Reticulitermes lucifigus. *A Shell photograph.*

found from experimental work that even very low concentrations of these insecticides, e.g. 0.05% w/w aldrin or dieldrin in hardboard, gives good protection against termite attack. Both aldrin and dieldrin incorporated in this way provide a cheap method of protecting wood products against insect attack. Further work is to be carried out to determine the degree of persistence of this treatment.

Organic solvent type preservatives

Dieldrin has been used as an insecticide in a number of well established organic solvent preservatives for many years. However, in order to be effective in preventing or eradicating fungal attack as well as insect attack, these preservatives also incorporate fungicides such as pentachlorophenol, orthophenyl-phenol, metallic naphthenates and chlorinated naphthalenes. Such products are used in tropical as well as temperate countries[12]. Two classes of organic solvent type preservatives are available. In the first class, dieldrin and other active ingredients are absorbed in a solvent such as gas oil or diesel oil with a relatively high flash point and may be applied by steeping or the hot and cold process to timbers to be used in contact with the ground or in other situations where attack is likely to be severe. Dieldrin based products of this type are widely used — for example in Indonesia[13].

With the open tank method of application, the preservative is normally heated together with the wood to about 180°F. Although dieldrin is stable at elevated temperatures, slight loss could occur if the preservative is maintained at this temperature (180°F) for more than 10 hours.

Where prolonged heating of the dieldrin-based preservative is necessary, as it may be with large dimensional timbers, any possibility of loss of insecticidal activity could be virtually eliminated by heating the timber in the pure solvent, and when completely heated through, transferring it to a tank of cold preservative.

In the second class the solvent is a light petroleum distillate, kerosene or white spirit. This class of organic solvent type preservative is applied by dipping, brushing or spraying and may be used for protecting internal timbers not exposed to severe weathering. Products of this second class are also used for eradication of woodworm and rot from building timbers, furniture, panelling, etc.

Dieldrin also finds application in such household products as insecticidal stains and polishes and woodworm killing fluids supplied in either the conventional form in tins or in pressure packs provided with injection tubes.

"Woodtreat" formulations

A new type of preservative has recently been introduced in the United Kingdom and Commonwealth. Sold under the name of "Woodtreat"[13] this was developed in the United States and is essentially a product based on organic solvents and formulated as a gel-like mayonnaise emulsion. The manufacture of this product is covered by patents. As currently sold in the United States, it is based on pentachlorophenol alone, but certain of the "Woodtreat" formulations now being manufactured by the U.K. licensee contain dieldrin as well as pentachlorophenol.

"Woodtreat" is principally designed for the *in situ* treatment of timber, the material being applied to the surface of the timber either as ribbons or as a complete covering to the wood where it sustains itself, providing a reservoir from which the dieldrin and pentachlorophenol in the emulsion are absorbed into the wood.

These preservatives provide a useful method of treating wood *in situ* both to eradicate pests already present and to prevent further attack. A high degree of penetration and retention of the preservative is obtained when it is correctly applied.

Safe handling

Dieldrin like pentachlorophenol and some other chemicals used in organic preservatives, is toxic to

humans and other warm-blooded animals. It can be absorbed by ingestion, inhalation, or through the skin; the latter being the most hazardous when handling wood preservatives containing dieldrin.

Precautionary recommendations are similar to those which should be followed when handling pentachlorophenol. Thus in the factory, properly designed exhaust ventilation and a good standard of hygiene in the plant is required. Employees should wear overalls, rubber boots and unlined PVC gloves; all such protective clothing should be kept clean and in good condition. Before eating and changing after work, workers should wash thoroughly.

Extensive use of dieldrin during the last five years for wood preservation in the United Kingdom and elsewhere has shown, however, that dieldrin can be handled safely during both formulation and application provided elementary precautions are taken.

When dieldrin formulations are applied in confined or poorly ventilated spaces, where the risk of heavy personal contamination may occur, additional precautions such as the wearing of spray mask or a rubber apron may be necessary.

Care should be taken to ensure that unwrapped foodstuffs do not come into direct contact with freshly treated wood. Provided the dieldrin-based wood preservative is formulated so as to minimise migration of the insecticide to the wood surface during drying, or has had a finish impermeable to dieldrin applied, e.g., a paint or varnish, there is no danger to the health of humans and domestic animals.

Analysis

For purposes of quality control it is necessary to be able to determine the amount of dieldrin in preservatives and in wood treated with them. Dieldrin can be determined in preservatives by a determination of the organic chlorine content if other chlorinated compounds are absent or by infra-red spectrophotometry. The latter method requires expensive and complicated equipment not available in many laboratories.

When determining dieldrin in treated wood it must first be extracted and the extract "cleaned up". Infra-red spectrophotometry is the best method of determination but if the necessary equipment is not available consideration should be given to the phenyl azide method, organic chlorine determination or even to a bioassay

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TICKS, MITES AND DISEASES

PART TWO

ASSOCIATED DISEASES

By G. LAPAGE,* M.A., M.D., M.Sc.

In Part I, published in our December issue, the author gave a brief, introductory outline to the biology of ticks and mites. In the following account Dr. Lapage indicates their economic importance.

DISEASES DIRECTLY CAUSED BY TICKS AND MITES

BOTH ticks and mites directly injure their hosts by piercing the skin in order to obtain blood or lymph. Their "bites", as they are somewhat erroneously called, cause irritation and this, especially when ticks or mites are numerous, may be enough to injure the general health of the host and may, for this reason, make it less able to resist diseases of all kinds. Irritation causes restlessness, loss of sleep and appetite and consequent weakness and loss of weight. This may be less evident in human beings plagued by ticks and mites, but in some domesticated animals, such as sheep and cattle, which may be infected with hundreds, or even thousands, of the larvae, nymphs and adults of some species of ticks, or with the corresponding phases of mites, the mere effects of the irritation thus caused may be important. The egg production of poultry and the milk yield of cattle may be lowered and the general health of the animals affected.

A second form of injury inflicted is loss of blood. The mites do not remove appreciable amounts of blood from the hosts, but some species of ticks certainly do, especially when their greed for blood is combined with the paralysis of the host caused by some species of tick (cf. below). Thus Fiedler has pointed out that the soft tick, *Otobius savignyi audouin*, which attacks cattle in the Kalahari desert in South Africa, may quickly paralyse calves and heifers, so that they collapse. The ticks may then drain them of blood to such an extent that they die in half an hour.

The amounts of blood removed by other species of ticks are not, however, so large as this. Lees, for example working in Britain, estimated that each adult female castor bean tick (*Ixodes ricinus*) takes in about 0.57 m. (600 mg.) of the blood of sheep on which it is parasitic. The hosts are commonly infested, not only with the adult male and female ticks, but also with their larvae and nymphs born in previous years and although these earlier stages in the life history no doubt remove less blood, they may be so numerous that their contribution to the total loss of blood, during the 30 spring days or so when they are feeding, is certainly not negligible. In one experiment Heath estimated that the ratio of larvae, nymphs and adult females on each of the sheep he studied would be 960 larvae : 8.5 nymphs : 1 adult female tick. Using this ratio he calculated that the approximate loss of blood inflicted on the sheep during the 15 weeks between March 15 and June 30 when the ticks were feeding would be :

Ticks	*Ml. of blood removed*
265 adult females	152
265 x 8.5 nymphs	45
265 x 960 larvae	1,052
Total	1,249

However, experiment has shown that a sheep can survive even when it loses 3.2 litres of blood during a period of 14 days, although removal of this amount of blood during 66 hours will kill it. It is evident, therefore, that sheep, and no doubt cattle and other hosts of ticks, can withstand the loss of quite remarkable quantities of blood and that it is more likely that death or illness which may at first sight seem to be atributable to loss of blood is due more to other causes.

Both ticks and mites cause inflammation (dermatitis) of the skin and hosts thus afflicted bite or scratch the skin and thus may increase the injuries. When, as often

* *Late lecturer in Animal Pathology and Parasitology to the Institute of Animal Pathology, University of Cambridge.*

happens, these injuries become infected by bacteria, abscesses may result, and these and any other injuries present, may attract, to farm animals at any rate, insects which may cause or transmit disease. Important among these insects are the blowflies causing the disease of sheep called 'strike'. The flies, attracted by the sores or abscesses, lay their eggs in them. The hatching maggots feed on the sores and may burrow into the tissues under the skin, so that extensive, purulent lesions may result. One of the main reasons, therefore, for controlling the attacks of ticks is that control of them lessens the risks of the occurrence of strike.

One other form of loss inflicted by ticks may be mentioned here. This is the damage that they may do to the hides of cattle. Thus Seddon has stated that, in Australia, some 70% of the hides of Queensland cattle, and all those of the northern part of the Northern Territory and the Kimberley Division of western Australia, were, at the time when he wrote (1951), more or less damaged by the bites of ticks and that the financial loss due to this cause alone was £100,000 a year. If we add to this the reduction of the milk yield of dairy cattle caused by the irritation due to 'tick-worry', it is clear that there is, for economic reasons alone, ample reason for the energetic measures that are taken against ticks. So far as man is concerned the ticks affect him, not so much by the direct injuries they cause, for man can easily deal with these, as by the serious diseases which they can transmit.

Mild inflammations

The diseases and direct injuries caused by mites range from mild inflammations of the skin to the more serious skin diseases, such as scabies. Among the mild inflammations are the various forms of dermatitis caused by mites which are pests of materials handled by man; they attack man only when he handles these materials. Thus grocers, bakers, copra workers and others may suffer from inflammations of the skin called grocer's itch, baker's itch, copra itch and similar names, due to mites that are pests of flour, grain, cheese, copra, etc. The mites parasitic on poultry may also attack people who handle or work with these birds. Most of these forms of dermatitis are however, relatively mild and with suitable precautions do not persist for long.

Also mild, though at times extremely irritating, are the itching papules caused by the bites of the larvae of the harvest mite, *Trombicula autumnalis*, which annoy man, and also dogs and other animals, especially during the late summer and autumn, when they have newly hatched out of the eggs. The nymphs and adults of all species of the genus *Trombicula* are harmless; they do not feed on the blood of animals. The six-legged larvae, however, suck the blood and lymph of man and other animals, causing the formation, at the sites of their bites, of small swellings the itching of which may be intense. The larvae feed in a manner which is unique. They puncture the host's skin with their toothed chelicerae and inject into the wound a fluid which dissolves the cuticle of the host's skin and forms a tube through which the larva sucks up, not the host's blood, but a fluid formed by digestion of the host's tissues by a fluid which the larva injects. It is probably the host's reactions to this foreign fluid which causes the itching papule just described. The minute larva, it will be noted, does not burrow in the skin, but stays on the surface. The larvae of several species of the genus *Trombicula* attack various animals in a similar way. *Trombicula sarcina*, for example, attacks sheep in Australia, causing irritation of, and sores on, the legs and feet of sheep, an effect similar to the sores and irritation caused in dogs, especially between the toes, by *Trombicula autumnalis*.

Sarcoptiformes

Much more important, however, than the mites just discussed, are the mites belonging to the group called the Sarcoptiformes, which cause scabies of man and the various forms of mange of domesticated and other animals. The adults of these are very small, the largest stages, the females, measuring not more than half a millimetre (1/50 inch) long. Usually their globose or oval bodies are whitish or grey, or, if they are tinged with blood they have sucked, reddish. The skin, is, in many of them, striated and may bear bristles or spines. They have no eyes and some of the walking legs bear claws and the cup-like suckers (caruncles) set on stalks. Their other characteristics need not detain us here.

The Sarcoptiformes are divided into two families. One, called the Sarcoptidae, includes the genera *Sarcoptes*, *Notoedres* and *Cnemidocoptes*, the other family, Psoroptidae, including the genera *Psoroptes*, *Otodectes* and *Chorioptes*. The Sarcoptidae burrow more or less deeply into the skin of the host, causing the skin to become wrinkled and thickened. The itching caused may make the host scratch or bite the skin and open sores may result from this. Species of this family are usually parasitic on one kind of animal, which is called the usual or normal host of the species, but they may also infect other kinds of animals, which are called their unusual or abnormal hosts. These species are therefore often given additional names to denote the kind of animal on which they are found. Thus *Sarcoptes scabiei* which uses the sheep as its usual host is called *S. scabiei* variety *ovis* : but it may also attack the goat, pig or man. *S. scabiei* which uses the goat as its usual host is called *S. scabiei* var. *caprae* ; but it may also attack the sheep, ox, pig, horse or man, and the other varieties of *S. scabiei* also have their usual and unusual hosts. Some experts prefer to regard these varieties of

each species as physiological races, rather than as true varieties. The disease caused is usually more severe in the usual host so that man, when he is attacked, as he may be, by varieties of *S. scabiei* which occur normally on sheep, goats, pigs, dogs or other animals, does not usually suffer more than a transient dermatitis caused by these varieties. He has his own variety of *S. scabiei*, which is called *S. scabiei* var. *humani* and, from this he suffers more.

Species of the family Psoroptidae, in contrast to those of the family Sarcoptidae, do not burrow in the skin. They remain in, or on, its surface layers and cause the exudation of lymph, which dries on the skin, so that thick, heavy scabs are formed, rather than thickening or wrinkling of the skin. Further, the Psoroptidae are usually specific to their hosts and do not attack other animals.

Scabies of man

This disease is caused by *Sarcoptes scabiei* var. *humani*. The symptoms of the disease are due chiefly to the activities of the ovigerous female mites in the tunnels in the skin. The female is usually found at the blind end of the tunnel, which takes a more or less twisted course in the skin. Mating usually occurs after the male, seeking a female along the outside of the skin, has located her and has burrowed down to her. The female mite situated at the blind end of the burrow, continues to extend it and, as she does so, lays her eggs. She may lay two or three eggs a day for nearly two months and then she dies. The various stages of the mite which develop from the eggs are, like the adults, more active at night, but this does not fully explain why the itching caused by this mite is also worse at night.

Larvae hatch out of the eggs in the burrow in 3 to 5 days after the eggs are laid and they either stay in the burrow in which they are laid, or make new burrows, or escape onto the surface of the skin and burrow into it elsewhere, even at times getting into the follicles out of which the hairs grow. About 4 to 6 days after hatching from the eggs, the larvae moult their skins and become 8-legged first nymphs, which also may make new burrows. Some two days later the first nymphs moult to become either males or pubescent females and two to four days later, the pubescent females develop eggs and become ovigerous females ready to be fertilised. The whole life history may be completed in 10 days, but more usually requires about 2 weeks. Although each female lays about 40-50 eggs before she dies only about 10% of the eggs give rise to adult mites. The number of the mites that cause human scabies seems to be much less than the numbers of the mites found on animals suffering from the various forms of sarcoptic mange.

The symptoms of infestation are that reddened patches appear, especially on the hands and wrists, though also, in some patients, on the feet and elsewhere on the body and characteristic itching begins. Vesicles full of fluid may also appear under the burrows of the mites. The scratching by the host may open the burrows and set free fluid from the underlying vesicles. As this fluid dries, scabs are formed and, if bacterial infection occurs, the condition becomes worse. Mellanby considers that the intense itching that occurs is due to a sensitisation of the patient, shown by the appearance of the vesicles, and this view is supported by the fact that the vesicles may appear on the hands and feet in places where there are no burrows and may persist for weeks after the mites have been killed.

The mites can live off their host for about a week, during which time the female may continue to lay her eggs. These eggs, and the larvae and nymphs derived from them may be present in the clothing and bedding of infected people. Some authorities consider that infection is mainly acquired from this source, while others hold that it is chiefly acquired by direct contact between the skin of an infected person with that of an uninfected one.

Sarcoptic mange

The skin diseases directly caused by the other varieties, or, as some prefer to call them, physiological races of *Sarcoptes scabiei*, differ in many ways from human scabies and are given the general name of sarcoptic mange. The first symptoms of this disease in any animal are usually irritation and itching similar to that caused by mites in general. Red papules and vesicles appear on the skin and probably these are due, as they seem to be in man, to sensitization of the animal. The subsequent effects, are different from those seen in human scabies. The irritated skin becomes thickened and wrinkled and the hairs fall out, because their blood supply is limited or cut off. Bacterial infection often occurs and adds to the damage done.

Notoedric mange, caused by *Notoedres cati* is similar to sarcoptic mange and though it especially attacks the external ear of cats and rabbits it may also appear on the tail.

Depluming itch and Scaly leg

Two species of the genus *Cnemidocoptes* cause serious diseases of hens. *Cnemidocoptes gallinae* burrows into the shafts of the feathers of the fowl and some other birds and causes, as the other mites do, inflammation and itching. The results of the activities of the mites are that the feathers easily break off and may be pulled out by the irritated birds, which may then acquire an injurious habit of eating feathers. The feathers

affected first are usually those of the rump, though the large tail and wing feathers do not usually fall out. Later the mites spread to the feathers of the back, abdomen and thighs. Quite large areas of the body may thus be denuded, the skin of these areas usually being normal. The general health of the birds is, in general, not much affected, though the irritation caused by the mites cannot be good for them. The disease is especially common in spring and summer and in winter may disappear.

Cnemidocoptes mutans, a mite similar to *C. gallinae*, causes a disease called Scaly leg of the fowl, budgerigar and some other birds. Typically it affects the legs. The mite burrows beneath the large scales on the unfeathered lower part of the leg, causing irritation and inflammation, with the result that a powdery material is formed beneath the raised scales. This process, going on for several months, results in the formation of large, rough, yellowish crusts around the distorted scales and under these crusts are oval vesicles, in each of which a mite may be found. Removal of the crusts exposes inflamed, moist tissues beneath. The birds peck at the crusts, although the irritation caused is said to be only moderate. The joints of the toes may also be affected; accumulation of the crusts may cause lameness and severe infections may result in arthritis and loss of one or more toes.

Psoroptic mange

The disease caused by the varieties of the species *Psoroptes communis* is generally known as psoroptic mange, which differs considerably from sarcoptic mange, one reason being that varieties of this species, like the other psoroptic mites, do not burrow into the skin, but stay on its surface layers. They do not, for this reason, cause the thickening of the skin that is characteristic of sarcoptic mange, but suck the host's body fluids through the surface of the skin and thus cause the exudation of lymph, which dries on the skin to form scabs. The disease is therefore known as scab, the best-known form of it being perhaps *sheep-scab*.

Psoroptes communis var. *ovis*, which causes this disease, lays its eggs on the skin of sheep. The eggs hatch in 1-3 or more days, liberating the six-legged larvae which feed on the host's body fluids for 2-3 days and then moult to become 8-legged nymphs. The nymphs, after 3-4 days, then become males and females, which mate and produce more eggs, the time elapsing between one generation of eggs and the next being only about 8-9 days. The female lays about 5 eggs a day and lives some 30-40 days. The rate of multiplication of the numbers of these mites is therefore rapid. Sheep are infected by contact with other infected sheep, or, sometimes, by mites which have left the host. Off the host mites can live up to 38 days, but generally speaking will die in 17 days or so, so that sheep cannot get the infection from premises left unoccupied for about this period.

The mites first cause small, yellowish papules, which the sheep bite and lick. A few days later yellowish crusts are seen, the wool falls out or is bitten off by the sheep, the crusts darken in colour and the disease spreads. In severe cases it may cause the extensive loss of wool. In Britain the infection was, before it was virtually eradicated, commoner in hill and moorland areas where sheep range widely and mix together. It is commoner in the cooler months of the year and may occur on any part of the body of the sheep, although it is, in wooled sheep, commonest round the shoulders and sides of the body, and in hairy sheep along the back and upper surface of the tail and over the sternum. Sheep in poor condition are more often attacked than healthy ones. In healthy sheep, which resist the disease well, and during the summer months when the mites are less active and produce fewer eggs, the infection may persist in what is called its *latent* form, a term which refers to its persistence in the ears, below the eyes and in the groins. Inspection of sheep may overlook this latent form of it and in these situations it may escape treatment by the acaricides which have virtually eradicated this dreadful disease from sheep in Great Britain, Australia (from which country it has been eradicated twice) and some other parts of the world. The form of psoroptic mange caused by various races of this species of mite in the goat, horse, rabbit and in cattle is essentially similar.

Bovine scab—sarcoptic mange—Windsor, 1950. Photo Cooper, McDougall & Robe

Top: An early case of sheep scab. Bottom: Sheep scab in an advanced stage. Photos Cooper, McDougall & Robertson, Ltd.

Other Psoroptidae include: — *Otodectes cynotis* which attacks the lining of the external auditory canal of the dog, fox, cat and ferret and probably other mammals. (The resulting affliction termed ear-mange, must not be confused with Notoedric mange.) The genus *Chorioptes* includes several species named after the host they infect. For example *C. equi* attacks the feet of horses causing "foot-mange" or "itchy leg" *C. ovis* causes a mild form of mange affecting the lower parts of the legs, the cheek below the eyes, or the genital organs of the ram.

Demodectic mange

Demodectic mange, which is caused by *Demodex folliculorum*, stands apart, because the mite lives, not on the skin, but head downwards inside the hair follicles. These mites, like the feather mites of birds are elongated, in adaptation to life in the narrow spaces in which they live. The life history of *Demodex folliculorum* includes the six-legged larva characteristic of all the ticks and mites, but following this there may be three nymphal stages instead of the one that ticks have. From the latest of these the adult males and females develop.

Much has yet to be learnt about the details of the life history of *Demodex folliculorum* and it has been suggested that, although the adults, and probably some of the nymphal stages preceding them probably live all their lives in follicles of the hairs, the earlier stages may pass into the tissues beneath the skin of the host, or even into its blood and some of its internal organs, such as the lymphatic glands.

Demodex folliculorum may infect the hair follicles of man, cats, sheep, horses and bovine animals, but in all these hosts the mange caused is relatively mild and, in cats and sheep, infections are rare. The dog is the host that suffers most and severe infections with this mite may kill a dog. Some experts think that severe demodectic mange occurs only when the dogs affected are in poor health, or are poorly fed and suffer from vitamin deficiencies, but other diseases, such as distemper, may predispose dogs to infection, and young dogs suffer more than older ones. The mange caused may be what is called scaly, squamous or red mange, when the skin becomes reddened and inflamed and intense itching occurs. The skin later becomes wrinkled and scaly and the hairs fall out. Later still the skin becomes bluish-green or coppery in colour. The dogs have a repulsive, mouse-like smell. Squamous mange may be followed by a form of the disease called pustular demodectic mange, in which infection with bacteria occurs and pustules full of pus and abscesses are formed on the abdomen, on the inner sides of the legs and on the face and feet and the repulsive smell is retained. The method by which dogs become infected with *Demodex* is not fully understood. Probably infection occurs by contact, especially when the skin is warm, or when dogs are kept near together in confined quarters, or huddle together for warmth; but healthy dogs may live a long time with infected ones without aquiring the disease. Although *Demodex folliculorum* has been found in the hair follicles of man, attempts to transmit it from dogs to man have failed. In man it may be common and may invade the glands which secrete the fluid which lubricates the hairs, but there is no reliable evidence that it ever causes disease of the human skin.

Gamasid mites

This group of mites have bodies flattened from above downwards and are ovoid, pear-shaped or circular in

outline. Usually they have on their bodies chitinized plates and their four pairs of legs have no suckers, but are provided with claws. The parasitic species have needle-like chelicerae with which they pierce the skin of the host, but the hypostome has no teeth. Two species are important because they are parasitic on the fowl and other birds. These are .

(1) *Dermanyssus gallinae*, often called the red mite of poultry. The mature female is about $1\frac{1}{2}$ mm. long and it feeds on the blood of the fowl, pigeon, canary and other caged-birds. When it is unfed it is whitish in colour, but when it is full of blood, it becomes red. The eggs, though they may be laid on the host, are usually laid in cracks and crevices of the poultry house or other quarters of the birds and the 6-legged larvae that hatch out of them do not feed. In a few days they become 8-legged nymphs, which suck the blood of the birds and then leave them to moult in crevices in the birds' quarters. There are two nymphal stages, the second nymphs becoming adult males and females. The whole life history may be completed in a week or so.

These mites cause much irritation and, because they feed only at night, the birds suffer, in addition to the effects of the irritation, much loss of sleep. The mites may also multiply so rapidly and remove so much blood that they cause anaemia. The total effects may therefore be serious. Because they leave the host to lay eggs and the nymphs leave it to moult, control measures must include disinfection of the quarters of the birds as well as the birds themselves. *Dermanyssus gallinae* also transmits the spirochaete organism, *Spirochaeta anseris*.

(2) *Ornithonyssus sylviarum*, the northern mite of poultry, is parasitic on the fowl and various wild birds in Canada, the United States and Europe. It may attack man. It resembles another species, *Ornithonyssus bursa*, so closely that some experts think that it is a variety of this. The eggs of *O. sylviarum* are sticky and are laid on the host, while those of *O. bursa* are, like those of *Dermanyssus*, laid off the host.

The life history of *Ornithonyssus sylviarum* probably resembles that of *Dermanyssus gallinae* and can be completed in 8 to 12 days. Moulting of the stages of these mites may occur either on or off the host and, in sunny weather, the mites come to the surface on the feathers, especially round the vent and may, when the birds are handled, readily leave the birds, to bite tender parts of the skin of the person handling the birds. The mites feed only intermittently and often infest their nests. Heavily infected birds may suffer considerably from the irritation caused and from loss of blood, scabs may appear along the back, round the wing-joints and around the vent and, if these become infected with bacteria, the results are correspondingly worse. An odd and unexplained fact is that these mites seem seldom to attack young chickens. *O. sylviarum* transmits the organism causing fowl pox and other species of this genus transmit diseases caused by species of *Rickettsia*.

TRANSMITTED DISEASES

In the space of these articles we cannot describe in detail all the diseases transmitted by ticks and mites, but reference to certain facts about these diseases will help us to understand why it is so important to try to control ticks and mites.

The method by which these diseases, and, indeed, all other infectious diseases, are transmitted, varies according to the causative organism concerned. Bacteria which can survive outside the host may be transmitted by ticks or mites in a purely mechanical way. But the other organisms that ticks and mites transmit, namely, viruses, Rickettsias and Protozoa, cannot survive outside their hosts. When ticks or mites take them up with the blood or other tissue fluids of hosts infected with them, they get into the tissues of the ticks or mites in which they survive for variable periods of time. It is possible that some of them may be then transmitted more or less directly by the ticks or mites, but usually they must go through a series of developmental changes inside the ticks or mites before they can infect another host. The final result of these changes is what is called the infective phase of the organism concerned, the phase, that is to say, which alone can infect another host and it is, therefore, important, for control purposes, to know exactly how this infective phase is produced and how long it takes to produce it. It is also important to know all the possible hosts of the organism.

Hosts are, in fact, classified into those in which the organism thrives best, or in which it causes the disease we are trying to control and other hosts, called *reservoir hosts*, from which the vectors, namely, the ticks and mites we are considering, may derive the infection. Thus endemic typhus is also called murine typhus because it is primarily a disease of rats, but the organism which causes it, *Rickettsia typhi*, may also cause murine typhus of man. Because this form of typhus is primarily a rat disease, it breaks out in man only in areas in which it also infects rats and for this reason it is said to be endemic to these areas. It is transmitted from rats to man mainly by fleas, but from rat to rat, and perhaps occasionally from rats to man, it may be transmitted by the gamasid mite, *Ornithonyssus bacoti*.

This, however, is not all. Some kinds of organisms, when they get into the tissues of ticks and mites, pass into the ovaries of these arachnids. The consequence of this is that the eggs of the arachnids are infected with the organism and can pass it on to succeeding generations of the ticks or mites, a process which is called *transovarian transmission*. Only some of the

organisms transmitted by ticks and mites can be thus passed on to later generations of ticks and mites in this way, and this can happen only in some species of ticks or mites. Further some of these infectious organisms can be transmitted to vertebrate hosts only by the larvae of the arachnids, or by all the three stages of the life history, larva, nymph and adult. The elucidation of all the possible combinations of these various modes of transmission is therefore very complex and it cannot be considered in detail here. We must be content with a brief account of some of the diseases themselves.

Transmission by mites

Taking first the diseases transmitted by mites, we find that the most important human diseases are endemic (murine typhus) mentioned above and the disease called scrub typhus, mite typhus, Japanese river fever or tsutsugamushi disease. Scrub typhus occurs only in parts of Japan and in neighbouring areas in the Far East. It severely affected the Allied troops during World War II and seriously interferred with military operations there. It is caused by more than one species of *Rickettsia* and is transmitted to man by the larvae only of certain species of mites belonging to the genus *Trombicula*.

Ornithonyssus bacoti, in addition to transmitting, as has been mentioned above, murine typhus from rats to other rats, transmits human Rickettsial pox in America caused by *Rickettsia akari*. Statements that it can transmit Q fever are doubtful.

To birds *Ornithonyssus sylviarum* may transmit the virus that causes fowl pox (fowl diphtheria, roup) and *Dermanyssus gallinae* may transmit *Spirochaeta anserina*, the cause of spirochaetosis of the fowl and perhaps of other birds.

Tick borne diseases

These are so numerous that it is as well to classify them according to their causes :

a. Diseases caused by Viruses

These occur mostly in the Americas and the Far East. Thus Colorado tick fever in America is transmitted by the hard tick *Dermacentor andersoni*, which, like its relative *Dermacentor reticulatus*, which occurs in England, is one of the ornate ticks which have coloured plates on their bodies. *Dermacentor andersoni* also transmits an inflammation of the brain (encephalitis) caused by a virus in man and horses in the western United States, and perhaps together with other species of the genus *Dermacentor*, a disease called tick paralysis, caused by a virus, in sheep, cattle and dogs, in North America and Canada, which is transmissible to man. This form of tick paralysis must not be confused with the tick paralysis described below. In Europe and Far Eastern Russia and Siberia another tick, *Ixodes persulcatus*, transmits to man a form of encephalitis called, because of its seasonal occurence, Spring-summer encephalitis.

To sheep in Scotland and northern England the nymphs and adults only of ticks transmit the virus which causes the disease of sheep called *louping ill* or trembling disease. The virus does not pass into the eggs of the tick, so that the larvae are not born with the infection, but infect themselves by feeding on infected sheep and pass the infection to the nymphs and adults.

b. Diseases caused by Rickettsiae

An important human disease caused by Rickettsias and transmitted by ticks is North American or Rocky Mountain Spotted Fever, which is caused by *Rickettsia ricketsii* and occurs in western North America. It is transmitted to man by several species of ticks belonging to the genera *Dermacentor, Amblyomma, Rhipicephalus, Haemaphysalis* and perhaps other genera. Thus the lone-star tick, *Amblyomma americanum*, given this name because there is a single white spot on the scutum of the female, transmits Spotted Fever in Texas and Oklahoma and *Amblyomma cajennense* transmits this disease in Brazil and Colombia. *Dermacentor andersoni* and *D. variabilis* both transmit Spotted Fever to man in the United States and these and other ticks probably transmit other rickettsial diseases that occur in the Americas and are not yet fully understood.

Other rickettsial diseases transmitted to man by ticks are Boutonneuse fever found in the Mediterranean area and a similar disease called Tick-typhus found in tropical and central Africa, central Asia, Siberia, India and Malaya, and some typhus-like rickettsial infections of dogs, cattle and pigs. These diseases are transmitted by ticks belonging to the genera *Rhipicephalus, Dermacentor, Amblyomma* and *Hyalomma*.

To sheep, especially to lambs, ticks transmit a species of *Rickettsia* which causes Tick-borne fever, to which older sheep acquire an immunity.

c. Diseases caused by Spirochaetes

An important human disease caused by these organisms is relapsing fever. Thus *Borrelia duttoni* causes relapsing fever in man in Central Africa and is transmitted to man by the soft tick, *Ornithodoros moubata*. In North Africa and Spain another strain of this spirochaete is transmitted to man by *Ornithodoros erraticus* and other strains are transmitted by other species of this genus. Thus in northern South America and Central America the strain or species of spirochaete called *Borrelia venezuelensis* is transmitted to man by *Ornithodoros rudis*; in California and that neighbourhood another strain is transmitted by *Ornithodoros hermsi* and other species of *Ornithodoros* do the same in Mexico. The existence of these various strains of the spriochaetes transmitted by various species of the

genus *Ornithodoros* makes the study of this disease very complex, but clearly the species of this genus of soft ticks is one of the most serious pests of man.

d. Diseases caused by Bacteria

The most important human bacterial disease transmitted by ticks is Tularaemia. This is primarily a disease of rabbits caused by *Pasteurella tularensis*, which is related to the bacilli which cause plague. It can, however, also infect man and then causes a serious disease. It has been reported from various parts of North America and from Great Britain and across from Scandinavia to Japan. It can be transmitted by species of the genus *Dermacentor* and by the rabbit-tick, *Haemaphysalis leporispalustris* and also, in America, by *Amblyomma americanum*. Other vectors of it are deerflies, lice, fleas and bedbugs and it may be acquired by contact infection.

Another bacterial disease which may be transmitted by the hard ticks *Amblyomma cajennense* and species of the genus *Boophilus*, is the form of undulant fever called Brucellosis (not to be confused with a virus disease given the same name), which is otherwise acquired from infected water, milk or meat.

In addition to these diseases, the castor bean tick, *Ixodes ricinus* transmits to sheep the bacterial organism, *Staphylococcus aureus*, which may spread from the skin to the blood of the sheep, so that a disease called Tick Pyaemia results. The disease affects young lambs especially during the spring and early summer when the ticks are feeding on them.

e. Diseases caused by Protozoa

Ticks do not transmit to man diseases caused by parasitic Protozoa. They are, however, important vectors of serious protozoal diseases of domesticated animals and dogs. Because the Protozoa which cause these diseases must go through the essential sexual phases of their life histories in the ticks, the diseases could not occur if all the ticks were removed.

The Protozoa concerned belong to the Haemosporidia, and it is the asexual phases which parasitize the red blood corpuscles of the vartebrate host. Usually, the red blood corpuscles are either severely damaged or destroyed, the result being that the host suffers from anaemia. The products of the destruction of the red blood corpuscles may be discharged in the urine, turning it red. The name *Redwater disease* is therefore often given to the diseases in which this occurs. Other species of these parasitic Protozoa, however, cause symptoms, such as jaundice, associated with the liver rather than with the urine. We need not here discuss the structure or life histories of these parasites, but some aspects of the methods by which they are transmitted by ticks have important bearings on the problem of control of the ticks.

All the ticks involved are hard ticks. Some of them, such as *Boophilus annulatus*, are the one-host ticks described in the first article. Others such as *Rhipicephalus evertsi*, are two-host ticks. The majority of them, however, are three-host ticks, with the larva, nymph and adult feeding on separate hosts. These facts, taken together with the life histories of the hard ticks outlined in the first article of this series, must obviously be taken into account when we are trying to control these ticks and it is clearly important to know which species of ticks are involved.

Species of protozoa belonging to the genus *Babesia* may cause the disease called babesiosis or redwater fever of cattle and similar diseases of sheep, dogs and their relatives, and horses. Other Protozoa of this genus are parasitic in the blood of goats and swine. Two species attack cattle, namely *Babesia bovis*, which causes redwater fever of cattle in Britain, Southern Europe, South America and South Australia; and *Babesia bigemina*, which does not occur in Britain, but causes a serious disease, to which various names are given in different countries, of cattle in Europe, in South America and throughout Africa. It used to be prevalent also in North America, but control of the ticks involved has virtually eradicated it from this country. The tick which transmits *Babesia bovis* in Britain and Europe is usually the castor bean tick, *Ixodes ricinus*; in Russia it is *Ixodes persulcatus*. In South America and Australia *Babesia argentina* is transmitted by species of the genus *Boophilus*. The ticks which transmit *Babesia bigemina* are species of the genera *Boophilus*, *Rhipicephalus* and *Haemaphysalis*. Species of Babesia that cause diseases of dogs in Europe (but not in Britain), India, Africa and the United States, are transmitted by species of the genera *Dermacentor*, *Hyalomma*, *Rhipicephalus* and *Haemaphysalis*. Those that cause redwater fever of horses and their near relatives do not occur in Britain but raise serious problems in Europe, Africa, India and the Americas. They are transmitted by numerous hard ticks belonging to the genera *Rhipicephalus*, *Dermacentor* and *Hyalomma*. To sheep and goats two species of the genus *Babesia* are transmitted by ticks of the genera *Rhipicephalus*, *Dermacentor* and *Haemaphysalis* and the single species found in swine is transmitted by *Rhipicephalus sanguineus* in Europe and by *Boophilus decoloratus* in Africa.

In addition to the species of the genus *Babesia* just mentioned, cattle, buffalo, sheep and camels may be infected with species of a related genus called *Theileria*, which causes in them a serious, but different, disease (theileriasis) and they are all transmitted to the hosts mentioned by hard ticks of the genera *Rhipicephalus*, *Hyalomma* and *Boophilus*. Thus *Theileria parva* causes virulent disease of cattle, called East Coast Fever, along

the East Coast of Africa and also in Rhodesia, Natal, the Transvaal and Cape Province, but effective control of the tick which transmits it to cattle has virtually eradicated it. Other species of this genus, usually less virulent, cause similar diseases of cattle in Africa, Transcaucasia, Indonesia, Japan and Australia, and of sheep in Africa and Egypt.

Yet another disease, caused by minute, dot-like parasites belonging to the genus *Anaplasma*, cause, in Africa, Australia, North and South America and Europe, but not in Britain, a disease of sheep and cattle accompanied by jaundice, called Gall-sickness, which is often fatal. The parasites are transmitted to the host by numerous species of hard ticks belonging to the genera *Ixodes, Haemaphysalis, Rhipicephalus, Hyalomma* and *Boophilus* and also by soft ticks belonging to the genera *Argas* and *Ornithodoros*.

Tick paralysis

It has been mentioned above that some species of ticks may cause a form of paralysis of their hosts, to which the name tick paralysis has been given. The cause of it is unknown; no infective organism has yet been found, but it may be due to a poisonous substance produced and injected into the host by the tick. Only female ticks can cause it and sometimes only one tick can bring it about. The paralysis is usually preceded by stiffness of the legs, but later the animal affected loses control of the co-ordination of all four limbs; it can move them, but cannot stand or walk. The paralysis may then progress to affect the throat and even the heart, and death may result. If the ticks are removed, the affected animals usually recover. The manner in which calves thus affected may be drained of blood by the ticks so that they die in half an hour has been mentioned. The ticks so far known to be causes of this paralysis belong to the genera *Dermacentor, Haemaphysalis, Hyalomma, Ixodes, Rhipicephalus, Argas* and *Ornithodoros* and the animals known to have been thus affected are cattle, sheep, goats, dogs, ducks, geese and fowls and, in North America and South Africa, man.

It will be evident from this brief account of the diseases transmitted by ticks and mites and of the direct injuries they may cause that, apart from the suffering thus inflicted by them, the economic losses they may cause can be, if they are not controlled, very considerable. The next and final article will describe the methods nowadays used to control them.

Some New Spraying Machines For 1961

An indication of the new machines which will be in use in the coming year, in this case 1961, can always be obtained from a visit to the Smithfield Show which is held every December. By this time of the year manufacturers have had time to incorporate any improvements to their machines which may have been suggested by the experiences of the past spraying season. January is also the time of the year when several firms give public or private demonstrations of their new machines. This report is based on information obtained from these ' exhibitions '

However, the decision as to which combination of minor, moderate and major modifications constitutes the conception of new machine is difficult and must be arbitary, nevertheless it may be interesting to note the progress in 1961 of the machines mentioned in the following account.

E. Allman & Sons Ltd., during the summer of 1960 added a motorised knapsack sprayer and duster to their range of products (for details see *Pest Technology* **2** (8) 169). This compact machine, weighing only 50 lbs fully laden, was chosen by the Central Office of Information for exhibition at the Salonika Fair to represent one of the British achievements in the field of agriculture.

J. W. Chafer Ltd., introduced at the Smithfield Show a 200 gallon wet sprayer designed as a universal machine for applying most types of chemicals including liquid fertilizers.

In this machine the pump unit, tank and all parts coming into contact with liquid fertilizers are treated to resist corrosion. Two sets of booms are fitted, one of plastic to avoid corrosion and to provide the coarse spray pattern necessary to apply fertilizers, and the other with anti-drip U type jets for spraying. The spray booms have a 32 ft. coverage comprising one centre and two side arms fitted with patent swing-back hinges which fold vertically. The boom is adjustable in height from 18 ins. to 53 ins. The tank is fitted with capacity and pressure gauges and is so constructed that the machine can be converted from spraying at a high pressure to applying liquid fertilizers at a low pressure. The wheel track is adjustable from 56 ins. to 63 ins. with a tank ground clearance reputed to be greater than any row crop tractor; large size tyres ensure minimum ground pressure, three filters ensure trouble free application; stirring is by hydrojet; the tank is self-filling in under 5 mins. The delivery valve to the spray boom is fitted with a patent on/off slide which can be operated from the tractor driver's seat. A speedometer is fitted and designed to work only when the machine is spraying.

Cooper, Pegler, Ltd. recently introduced two pneumatic sprayers namely the ' Super 100 ' knapsack sprayer and the ' Hawk '. The Super 100 knapsack sprayer is similar in appearance to the company's Eclair model but is fitted with a piston pump the mechanism of which is mounted on needle roller bearings to reduce friction and to give maximum mechanical advantage with minimum effort. Provision is made for right or left handed pumping. Weight when empty is 17 lbs. The copper tank has a capacity of 3¼ gallons and an agitator can be supplied as an optional extra. The normal working pressure is 100 lbs/sq. in.

The "Hawk", Cooper Pegler's one-gallon pneumatic sprayer.

Chafer's 200-gallon Q.F. wet sprayer liquid fertiliser model.

and maintainance is stated to be negligible.

The 'Hawk' which was introduced during the latter half of 1960 is a pneumatic sprayer somewhat reminiscent of a cowboy's canteen or a compressed sputnik. It is constructed of heavy gauge brass and can be used for spraying all liquids—even creosote—with the exception of liquid acids. As with the Super 100 a variety of nozzles for various applications can be fitted to the spray lance, which is fitted with an instantaneous spray control valve. Simplicity of operation is the keynote and pressures up to 100 p.s.i. can be safely used to ensure that all the contents are discharged by the initial charge of air and that no pumping is required whilst spraying.

The Dorman Sprayer Co. Ltd., have produced only one machine which could be regarded as new, namely the sugar beet band sprayer which made its first appearance in July 1960 at the Royal Show. However, several modifications have been made to most of the company's machines since last year one notable change being the use of non-corrosive plastic spray booms.

With the present increasing interest in band applications the Band Sprayer designed for the pre-emergence application of herbicides to sugar beet is an intriguing piece of equipment. The sprayer is designed for use in conjunction with precision drills and is available with suitable brackets and fixings to suit most makes of tractors and seeders. The tank is mounted directly on the tractor giving ample room for manipulation of the seeder unit when mounted on the hydraulic linkage. The drive to the pump is arranged to suit individual seeders according to their method of drive.

The standard machine has a tank, (capacity 60 gallons), of all steel welded construction and hot dip galvanised after manufacture. It is fitted with hydro-ejector agitator, large diameter charging hole with splash proof lid and strainer basket. A large capacity fine mesh filter is fitted between tank and pump with isolating valve and connection for suction filling. An independent pressure regulator is fitted to the pump and a baffle is fitted on the front of the tank to prevent spillage from the tank coming into contact with the operator.

The pump is the improved Hyproroller vane type with hard chromium lined body and nylon rollers. A manifold is provided with connections for 6 lances, 2 being fitted with control taps to isolate them as required. The standard sprayer is supplied with 5 lances each fitted with the Dorman No-Drift nozzle with filter to apply 8 ozs. per minute on a 7″ wide band at 12 p.s.i.

The Universal model is similar but has a special chassis enabling the sprayer to be mounted in the high position for use with a seeder and in the normal position for crop spraying.

The herbicide to be used in conjuction with the sprayer is a disodium endothal/propham mixture sold in the U.K. by the Murphy Chemical Co., under the trade name 'Murbetex'. Representatives of this company were present on the Dorman stand at the Smithfield Show and it is most gratifying to see chemical and equipment manufacturers working in co-operation to produce both the materials and the method of application as one process.

Micron Sprayers Ltd., in common with the majority of manufacturers have carried out modifications during the past year to several of their machines and improvements to the well known Micronette have led to the production of a new machine known as the Micronette Mark II. Like the original Micronette the Mark II is a lightweight concentrate sprayer for use in top fruit, soft fruit, horticultural and glass house crops and employs a rotary atomiser to produce fine uniform spray droplets. However, new features include (i) a re-designed trolley unit whereby nearly all the weight falls on the wheel; (ii) a JLO engine designed to run at 5400 r.p.m. to give finer atomisation (iii) the sprayer is now drawn behind the operator and shielding of the basic unit reduces the amount of spray falling on the operator and the engine (iv) a recoil starter is also available.

Perhaps one of the most intriguing exhibits of the Smithfield Show was the prototype Micron Mantis an entirely new addition to the company's range that has been designed primarily for top fruit and hops though it also appears

Micron Sprayers "Micronette Mark II".

The prototype "Micron Mantis" (the commercial model will be more streamlined).

ideally suited for the spraying of blackcurrants. Capable of a high output of work it is suitable for the medium grower, yet its price (about £195) brings it within the reach of the smaller grower. A special feature of the machine is the wide angle outlet which produces a very large volume of air at low velocity—ideal for uniformity of cover under all conditions.

In common with other Micron machines, the Mantis has a rotary atomiser which produces the fine uniform spray droplets essential for concentrate spraying. Normal application rates range from 2-5 gallons per acre.

The sprayer has been designed for attachment to the tractor three point linkage and is driven from the tractor p.t.o. by a Hardy Spicer self-adjusting shaft. Fenner belting conducts the drive to the 18″ fan. The atomiser, mounted in front of the fan revolves at 5,500—6,000 r.p.m. Agitation and liquid feed is provided by a Stuart Turner centrifugal pump. Feed rates are controlled by different size restriction jets.

The vertical direction of the spray beam may be altered to suit different sizes of trees.

Drake and Fletcher Ltd., following the success during 1960 of their standard " Victair " machine (it is reputed to have created a sales record for this type of machine) have produced a larger and smaller mistblower based on much the same principles of design.

All of the three machines are suitable for hops, currants, coffee, apples, pears and citrus. The air out-put in each case is around 9,000 cu. ft/min. at an air speed of 140 m.p.h. (10,000 cu. ft/min. at 135 m.p.h. with the Super) and therefore all of them are capable of tackling the biggest of fruit trees. All are tractor mounted p.t.o. driven machines with a choice of 150, 200, and 250 gallon trailer tanks and a choice of standard or unimist nozzles if required .

The luxury model, the Victair Super, is intended for the large acreage grower and retails at about £585, excluding extras. It has powerful twin fans, directionally adjustable to give double sided spraying, wide area spraying or single sided spraying, whilst still maintaining full output. The fans, chain driven from the p.t.o., are capable of producing an air stream of 10,000 cu. ft/min. at an air speed of 135 m.p.h. and which with single sided spraying at least should be capable of carrying the spray right through even the largest fruit trees.

The spray liquid is transported from the trailer tank to the nozzles by means of a Birex double-acting ram pump with a working pressure up to 300 p.s.i. and an out-put of 14 g.p.m. Like the fans it is chain driven off the p.t.o. Both the drive to the fans and the pump can be adjusted to give, respectively, different speeds and pressures at the same tractor speed. Application rates between 20 and 375 gallons per acre can be used.

The Victair Junior retails at about £295 and is aimed at the smaller growers and the aim in its design has been to economise in production costs. There is only one fan which is driven off the p.t.o. by means of 6 Spacesaver high duty Fenner V belts. The fan produces an air stream of 1,000 cu.ft/min. for approximately every 100 revs of the p.t.o. shaft and at a p.t.o. speed of 700 r.p.m. will produce 9,000 cu.ft. of air per minute at an air speed of 140 m.p.h., which should enable penetration of the largest trees with single sided spraying. The pump transporting the spray liquid from tanks to nozzles is of the positive displacement diaphram type operating directly off the p.t.o. and at a p.t.o. speed of 720 r.p.m. gives an out-put of 5½ galls per minute; maximum working pressure being 100 p.s.i.

The standard narrow arc fan casing used for top fruit spraying, is directionally adjustable, but unlike the Super this cannot be done from the driving seat. An alternative outlet which can be fitted in 10 minutes, is available for the double sided spraying of hops, cordons, and bush fruit, however, the large Victair type nozzles cannot be used in this event and must be replaced by smaller ones.

Application rates are from 20 to 120 galls/acre in average fruit or up to 200 galls/acre in hops.

Evers & Wall Ltd., are to market two new crop sprayers and a 12½ gallon horticultural sprayer.

The ' Everall S.S. 100 ' high/low volume sprayer is an all purpose machine with a stainless steel, or alternatively a hot-dipped galvanised, self filling tank and has an out-put up to 1,200 galls/hr. The 25 ft. spray boom is in 3 sections so that the wing booms can be folded back independently to avoid obstacles and returned automatically to the spraying position without the driver moving from his seat. The boom height is adjustable. Two sets of ceramic tipped fan jets are supplied with each sprayer and given an out-put up to 20 gallons per acre at 4 m.p.h. Alternative nozzles can be used to obtain application rates up to 100 galls/acre. The fitting of an assembly which incorporates the use of a Schrader valve ensures freedom from drip and dribble.

It is stated that this equipment, apart from satisfying all spraying requirements, can also be used for washing down yards, sheep jetting etc. and in emergency as a fire fighting unit.

The other new machine, the Everall 75 is similar in many respects to the S.S. 100, except that the tank capacity is 75 gallons and it is fitted with a roller vane pump with an

Drake & Fletcher's "Victair Super" mist blower in action, showing double-sided spraying.

out-put of 800 gallons/hr. The spray boom width is normally 18 ft. and the use of alternative nozzles increases the out-put range to 70 galls/acre.

The hand propelled 12½ gallon wheelbarrow unit can be equipped with a boom or hand lances. The centifugal pump will give up to 240 gallons per hr. at 75 p.s.i. and is powered by a Briggs & Stratton 4 stroke petrol engine. The Schrader valve system which gives immediate spray pressure is also incorporated in this machine which is suitable for several horticultural purposes.

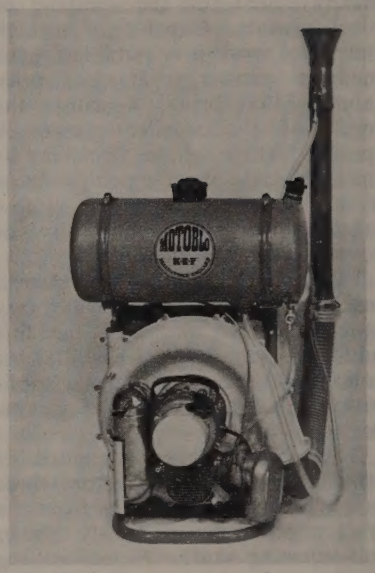
Kent Engineering & Foundry Ltd. showed for the first time at the Smithfield Show the ' Powermist Major ' a heavy duty, tractor mounted, top fruit sprayer, designed for trees of all sizes and stated to be capable of applying the full range of commercial application rates.

The unit comprises at 35-gal. per minute reciprocating pump working up to pressures of 250 p.s.i., direct mounted on to a specialised gearbox which transmits power from the power take-off of the tractor to the axial flow fan through the centrifugal coupling. The fan produces 40,000 cu. ft. min. of air at 110 m.p.h., making it specially suitable for use where larger quantities of wash per acre are to be applied. The trailer tank holds 200 gals. and is mounted on 600 x 19 tyres.

Modifications have also been made to the company's ' Motoblo 60 ' motorised knapsack sprayer improving its performance and reducing the weight to 27½ lbs.

Kestrel Engineering Ltd. produced a machine, the " Cascader " which was intriguingly designated as a " tractor mounted swirl moleculator ". The Cascader is driven off the p.t.o. and can be fitted by a 3 point hydraulic linkage to the tractor tool bar.

Chemicals are pumped from the 35 gallon galvanised sheet steel container to the 8 jets by means of a 3.5 h.p. double acting single piston pump which delivers up to 4 gallons/minute. Spray from the jets enters an air stream produced by a 14" diameter axial fan revolving at 3,500 r.p.m. producing an air speed of 120 ft./min. and an air supply of 6,000 cu. yd/hr. The whole serves to produce a highly atomised concentrate spray, which can be deployed through 180 degrees (or single sided spraying if required) at a maximum row width up to 3 yds.



The K.E.F. Motoblo "60".

Other recent additions to the company's range included the 'Minipak' a motorised knapsack mist sprayer, duster, and flame thrower, together with its ' big brother ' the " Powapak " which has a higher powered engine and improved performance.

NEWS AND NOTES

Polythene Packs For Sterilizing Liquids

A new method of packaging the troublesome liquids used for washing and sterilising dairy equipment, is announced by the Vigzol Oil Co. Ltd., Greenwich, London, S.E.10.

Known as the ' Poly Twin-Pack ', it consists of two containers, each of 2¼ gallon capacity, filled with Germex—a Ministry approved hypochlorite manufactured by the Vigzol Oil Co. Ltd,. and detergent respectively. Made of strong corrosion-resistant, rigid polythene, the containers are easy to pour and, more important still, are non returnable. They can therefore be re-used for storing vaporising and other oils, petrol, weedkillers and fertilisers.

These containers are stated to be a considerable improvement on glass carboys and the limp plastic containers at present on the market. Consequently they eliminate the only disadvantage of liquid as against powdered products—handling difficulties.

Liquids packed by this new method are cheaper than powders whilst at the same time offering the farmer containers for re-use. Retail price of the twin-pack, together with liquids and a measure, is 60/-. Shelf life of the hypochlorite is 10 months.

Superstition affects Malaria Control

Information from the Federation of Rhodesia and Nyasaland states that the intimidation and superstition which has hampered the work of smallpox inoculation teams in Nyasaland is also being encountered to a lesser degree by malaria control teams in the north-eastern part of Southern Rhodesia. Since about June this year, rumours have been rife that certain Africans who have been " marked "—a vague term which might include even a stain on an item of clothing—would lose their minds at a certain time and climb on a truck which would take them to Salisbury. There they would be changed into cattle, killed and canned. It has been spread about that the malaria control team are associated with this scheme, and it has also been alleged that the anti-malarial pills they hand out will cause sterility; the result has been a lack of co-operation by Africans, and assaults on two of the African field assistants. This state of affairs—mentioned to the Federal Ministry of Health in reports by four different Field Officers covering the period August 29 to October 10—at present applies only to the Darwin, Mrewa and Bindura areas of the Colony; it has not yet had any regional or general effect on the incidence of the disease. It seems to be a typical example of cutting off one's nose to spite the face.

Training Course on Rinderpest Diagnosis

There has just been held in Muguga, Kenya, a training course for veterinarians on new laboratory methods for the rapid diagnosis of rinderpest. This was organized under the aegis of FAMA by the Inter-African Bureau for Animal Health and the East African Veterinary Research Organization.

The early recognition of an outbreak of rinderpest is most important to the measures against this grave disease of cattle. And this recognition has been made more difficult in recent years by the appearance of another, less serious, ailment (Mucosal disease) whose clinical conditions are very similar to those of rinderpest. A way around this difficulty has been worked out by the East African Veterinary Research Organization, where a rapid technique for diagnosing rinderpest in laboratories and without the use of susceptible animals has been evolved.

The training course, which lasted five days, was designed to enable this technique to be explained and demonstrated to other veterinarians working in Africa by Drs. Scott and Brown who had been largely responsible for its development.

Eleven veterinarians attended this course in the laboratories of the East African Veterinary Research Organization. They came from Ethiopia, Northern Nigeria, Northern Rhodesia, Somalia, Tanganyika and Uganda : they included technical assistance workers already at work in Africa.

Dr. Furlong to Head A.P.T.C.

Dr. J. R. Furlong, O.B.E., has retired from the service of the Pyrethrum Board in Kenya to take over the London office of the African Pyrethrum Technical Information Centre from Dr. T. F. West. Dr. West is leaving his post as European Operations Executive of the Centre to become Editor of *Chemistry & Industry*, the Journal of the Society of Chemical Industry.

Dr. Furlong first became associated with pyrethrum while at the Imperial Institute. For many years he was Chairman of the Institute's Consultative Committee on Insecticides of Vegetable Origin and in 1946 he took a leading part in the survey of methods for the analysis of pyrethrum, which resulted in the world-wide collaborative scheme carried out in 1948/49.

Accompanied by Dr. Potter of Rothamsted, Dr. Furlong visited Kenya in 1952 to report on the industry at the invitation of the Pyrethrum Board. The following year he was appointed Scientific Adviser to the Board.

On the formation of A.P.T.I.C. he became its Liaison Executive and was responsible for co-ordinating the activities of the organisation's technical representatives throughout the world.

Dr. Furlong is also recognised for his work in the investigation of other Colonial plant and animal products, particularly with regard to hides, skins and sisal.

Rentokil Products Ltd.

As from January 2nd Rentokil Ltd. of Leatherhead, Surrey became Rentokil Products Ltd. to distinguish it from the various pest control servicing companies which form the Rentokil Group.

Rentokil manufacture woodworm killer, dry rot fluid, wood preservative, wood dye, mothproofer, Rentopol insecticidal polish, and aerosol products.

Cheaper Codling Control

Baywood Chemicals announce that Gusathion, an insecticide used for the control of Codling and Tortrix, will be much easier and cheaper to use next season.

It is now recommended that Gusathion may be sprayed without the necessity of wearing protective clothing, though a face shield and rubber gloves are still required while mixing the spray. This revision will take effect as soon as the appropriate amendment is made to the Agriculture (Poisonous Substances) Regulations and will thus bring Gusathion into the same category as Metasystox.

Detailed experiments have shown that the rates of use of Gusathion may be safely reduced. The Company now recommend 1¼ pints per 100 gallons (high volume) or 2½ pints per acre (low volume).

The combined effect of this rate reduction and the recently announced price reduction is a big decrease in the cost of use. For example the fruit grower who gives 2 applications to 60 or more acres will be able to spray at a nett cost in chemicals, of 49/7d. per acre per application, compared with that of 70/- in 1960.

Boots the Chemists also announce that the price of their Codling Moth Spray (based on Union Carbide Corporation's Sevin Insecticide) will be reduced from 125s. to 117s. 6d. per 10 lb. pack. Pro-rata reductions will apply for quantity orders.

New Address For Wood Preservation Ltd.

Wood Preservation Ltd., formerly of 142 Sloane Street, London S.W.1., move their offices to 144 Camden High Street, London N.W.1. on December 29th. The new telephone number is Gulliver 7071-5.

Wood Preservation Ltd. are the sole agents in the United Kingdom for the Xylamon range of wood preserving products.

New Company to Manufacture Poultry Health Products in U.K.

Internationally recognised poultry health products are to be manufactured and distributed in this country following the setting up of a new company, Whitmoyer-Reed, Ltd. by Whitmoyer Laboratories Inc. of Pennsylvania and Whitmoyer (Canada) Ltd. of Toronto, one of the leading animal health organisations in North America, with over thirty years experience in the poultry field.

Existing plant at Riverside Works, Hertford Road, Barking, Essex has been taken over by the acquisition of the well-known firm of manufacturing chemists, R. F. Reed, Ltd.

Whitmoyer-Reed, Ltd. will specialise almost exclusively in health products for the poultry industry. These include: two new treatments for blackhead in turkeys, Carb-O-Sep which is used at a preventative level in the feed, and Hist-O-Sep, for treating an outbreak, and two coccidiostats, Whitsyn Coccidiostat, a feed preventitive and Whitsyn S an outbreak treatment which does not induce a haemorrhagic syndrome

The company will also manufacture Amythol, an economical inhalent spray which relieves colds and respiratory conditions in poultry; and respiratory conditions in poultry; and Hydrol, a concentrated litter spray and insecticide for controlling infestations of red mite,

fleas and worm eggs. Hydrol is also active against blackhead and cocci micro-organisms.

Where Is Thy Sting?

It is now generally agreed that there is little chance of eradicating wasps in New Zealand, says a bulletin issued by its Department of Scientific and Industrial Research.

But the invasion of New Zealand by the European wasp has its bright spot, it adds. On balance, wasps appear to do more good than harm by preying upon many types of flies and caterpillers which are far greater pests.

The information bureau of the department has issued a booklet on control of wasps, and this states that, while the most effective method of control is by destroying their nests, this is not entirely effective.

Destruction of queens is not effective because, even if 99 per cent of these could be destroyed, the other 1 per cent would repopulate the area during the following summer.

Within the relatively short space of fifteen years the wasps had become a pest not only to fruitgrowers but also to apiarists. The wasps, by robbing beehives during late autumn, could cause the death by starvation of whole colonies of bees.

The department states that the most effective control in these cases is to destroy all nests within 1,000 yards of an apiary, as wasps do not fly beyond this range. Scientific observation has also proved that wasps are individualists and do not, or cannot, inform others of the sources of their food as bees do. (*Forefront* 7 (7). 53.)

Research into Facial Eczema

Probably no problem has received so much concerted research in New Zealand in recent years as the disease of facial eczema, which has frequently caused serious losses of sheep and cattle.

At least five branches of the Department of Scientific and Industrial Research and three research stations of the Department of Agriculture have attacked the problem, investigating the disease and the mould *Pithomyces chartarum*, which causes it.

Studies by the soil bureau, in conjunction with the Manutuke research station near Gisborne, have shown that the fungus grows vigorously on freshly damaged or killed plant material. Pure cultures of the mould have been grown and prepared for other research organisations, and its growth in synthetic media has been studied.

The grasslands division has found that certain substances present in some common pasture plants, especially sweet vernal and red clover, are toxic to the facial eczema fungus. A systematic investigation of these anti-fungal substances has been carried out at the plant chemistry division, and two of the compounds have been identified.

Another line of research, at the fats research laboratory in Wellington, has been on the fatty acid composition of the fungus and related species.

New Dow Appointment

Formerly manager of the ethical drugs division of Aspro-Nicholas Ltd., Mr. F. R. Crabbe has joined Dow Agrochemicals Ltd., North Lynn, King's Lynn, Norfolk, as director of Marketing.

Mr. Crabbe, who is 40, has considerable experience in the veterinary and ethical drug fields, and before going to Aspro-Nicholas was sales manager of Vitamins Ltd., a company he joined originally as a salesman. He holds a diploma in management studies and the final certificate of the Sales Manager Association.

Laboratory Apparatus and Materials Exhibition

The second national Laboratory Apparatus and Materials Exhibition will be held in the Royal Horticultural Society's New Hall, Westminster, from June 19-22, 1961.

Sponsored by "*Laboratory Practice*" the exhibition is being held so that manufacturers of apparatus, materials and other products specifically produced for laboratories can show their equipment to scientists and laboratory executives in industry, research, education, medicine and national and municipal government. It is expected that every possible type of laboratory requirement will be shown and demonstrated during the four-day exhibition. Both British and overseas equipment will be shown and many overseas buyers are expected to attend.

The first exhibition of this kind in the UK was held in London in June and support was such that it is now to be a regular event.

Fumigation Services Ltd. Change Name

One of the oldest established pest control companies in the United Kingdom, incorporated in February 1924, Fumigation Services Ltd. of Barking, Essex, and Ossett, Yorks., now become Fumigation Division of the associate company, Disinfestation Ltd. Fumigation Services Ltd., joined the British Ratin Group (now the Rentokil Group) in January, 1958.

The Fumigation Division of Disinfestation Ltd. will continue to be engaged in fumigation and other measures for pest control of flour mills, provender mills, breweries and maltings, food processing plants, grain stores, ships, lighters, warehouses, and foodstuff commodities under sheets or in chamber. The Division also acts as consultant to these trades on pest problems, and in addition make and export fumigation plant and equipment to many overseas countries.

Mr. T. L. Knight, Director since 1931, has been with the company since its incorporation, and has long and varied experience of pest control work. He now becomes a Director of Disinfestation Ltd., in charge of the Fumigation Division. He has only recently returned from an extended Far East Sales tour for the Rentokil Group to discuss infestation problems and to promote sales of fumigation equipment.

The Fumigation Division will continue to operate from Pylon Works, Hertford Road, Barking and 1 Headlands Road, Ossett, Yorkshire.

The change of name is part of the re-grouping of companies which has taken place since the British Ratin Co. Ltd. became Rentokil Group Ltd. last November.